

**BROOKHAVEN NATIONAL LABORATORY
PROCESS ASSESSMENT FORM**

I. General Information

Process ID:	PO-820 (Rev 2)		
Process Name:	Electrical/Mechanical Equipment Maintenance		
Process Flow Diagrams:	PEP 820Dwg		
Process Description:	This process includes operations at the Accelerator Test Facility residing in Bldg. 820 (High Bay, Experimental Hall and associated areas) that are under the responsibility of the Physics Dept. The Collider Accelerator Group is a tenant at Bldg. 820 and outside groups (e.g. CAD, EP) also perform routine contractual work - electrical testing (Interlocks, Power Systems and Radio Frequency maintenance, and Controls and Diagnostics), and maintenance-decontamination of machine shop. The ATF Department operates a linear accelerator (LINAC) and a laser system that requires periodic maintenance.		
Div.:	Physics Dept. (PO)		
Buildings:	820		
Point of Contact/Review By:	K. Kusche	R. Liegel	M. Zarcone
Prepared by:	S. Ferrone	x5331	
Reviewed by:	R. Gill, ES&H Coordinator		K. Kusche

I. SIGNIFICANT ENVIRONMENTAL ASPECTS ASSOCIATED WITH THIS PROJECT:

For criteria, go to SBMS Subject Area titled Identification of Significant Environmental Aspects and Impacts

a	Industrial Waste Generation		Atmospheric Emissions		Historical Monuments/Cultural Resources		TRU Waste Generation
a	Hazardous Waste Generation	X	Liquid Discharge		Sensitive/Endangered Species and Sensitive Habitats		
	Radioactive Waste Generation	a, d	Storage or Use of Chemicals or Radioactive Materials		Env. Noise		Other Regulatory Requirement
	Mixed Waste Generation		Water Consumption		Historic Contamination (groundwater/soil)		
	Medical Waste Generation		Power Consumption		Soil Activation		

APPLICABLE REGULATORY REQUIREMENTS:

BNL **Subject Areas** that are applicable to this process:

++PI's should consider subscribing to the subject area subscription service as a means of staying informed of changes to the subject area requirements.

	Drinking Water		Radioactive Waste Management
	Environmental Monitoring		Regulated Medical Waste Management
X	Hazardous Waste Management	X	Spill Response
X	Liquid Effluents	X	Storage and Transfer of Hazardous Materials
	Mixed Waste Management		Transfer of Hazardous Materials On-Site
	National Environmental Policy Act (NEPA) and Cultural Resource Evaluation		Transfer of Radioactive Materials On-Site
	Non-Radioactive Airborne Emissions		Transportation of Hazardous Materials Off-Site
X	Oils/PCB Management		Transportation of Radioactive Materials Off-Site
X	Pollution Prevention and Waste Minimization		Underground Injection Control
	Radioactive Airborne Emissions		

I. Detailed Process Descriptions and Waste Determination

The operations of the Brookhaven National Laboratory (BNL) Accelerator Test Facility (ATF) are identified as 1.0 through 3.0. Process Flow Diagram 820-ATF graphically depicts the process inputs and outputs for this operation.

General Description of the ATF

In Building 820, there is a laser and a LINAC within the Accelerator Test Facility (ATF). For a detailed description of the ATF see: [ATF Description](#).

Maintenance Schedules

Maintenance is performed on the magnets and vacuum systems for the LINAC in Building 820 routinely. Vacuum pump systems are repaired as necessary. The mechanical and turbo-pump systems are maintained and/or repaired at either the Vacuum Pump Maintenance Shop in Building 535C or they are sent off-site to a qualified vendor. Maintenance that occurs on the LINAC and laser involves adjusting and fine-tuning the magnets. These maintenance activities do not generate any wastes.

Mechanical Maintenance Activities

Mechanical maintenance activities include maintenance of vacuum pumps used throughout the complex to create a vacuum in the LINAC beam line. Other mechanical maintenance activities primarily involve inspecting the hardware on the accelerators, beam lines, and related equipment. Parts are occasionally replaced or repaired as needed. Parts are usually being repaired at on-site machine shops.

Electrical Maintenance Activities

Outside BNL departments perform system maintenance such as: Interlocks, Power Systems (PS), Radio Frequency (RF), and Controls and Diagnostics. Each group is responsible for their own wastes generated at their own facility. This maintenance involved either no or minor environmental aspects. Aspects are limited to solder dross, scrap electronics, use of non-chlorinated solvents for cleaning (such as alcohol and acetone), and use of circuit freeze and air sprays. All ongoing activities at Bldg. 820 are monitored by regular Tier I inspections performed by the Physics Dept.

The CAD Interlock Group performs the interlock checks for the ATF. They are responsible for developing, repairing, and maintaining the interlocks and door switches on the ATF.





The activities associated with the group's work that have environmental impact are soldering activities, hand machining activities, circuit cleaning activities, and management of various wastes. Any wastes generated are accumulated at the satellite accumulation area for Bldg. 820.

1.0 General Maintenance-Related Wastes

The ATF Group's maintenance and installation work produces a variety of recyclable and non-recyclable wastes such as scrap materials, batteries (alkaline non-hazardous and universal wastes), silicon controlled rectifiers, capacitors, transformers, circuit boards, electronic equipment, wire, cable, and fuses. Guidance for disposing of wastes is followed in the applicable SBMS Subject Areas: [Hazardous Waste Management](#); [PCB Management](#); [Industrial Waste](#).

Specifically, the following wastes may be generated at irregular intervals:

- Hazardous batteries from equipment such as Ni-Cd, Nickel-Metal Hydride, Mercury, Lead-Acid, Cadmium and other hazardous types are managed as "Universal wastes" per [How do I Manage This Waste](#) (1.0.1).
- Silicon controlled rectifiers contain silver and lead, therefore they are classified as a hazardous waste. If generated, these items are to be packaged, labeled, and brought to the 90-day are for disposal through the EWMSD as hazardous waste. Mercury switches are also hazardous waste due to mercury content (1.0.2).
- Some of the equipment the group works with contains small dry capacitors and transformers (1.0.3), which are disposed of as industrial waste. Non-PCB oil-filled capacitors must be drained before being considered a scrap metal and the oil must be handled as "used oil". During FY01, the electrical systems were assessed by the NSLS Group for PCB containing capacitors (any pre-1979 oil filled capacitor likely contained PCBs). PCB capacitors found were replaced and disposed of as PCB waste. NSLS previously owned electrical equipment should no longer contain PCB capacitors, and therefore should no longer pose a PCB waste disposal issue. *(Note: there may be residual PCB contamination from historical seepage into the walls of the Klystron).* Scrap circuit boards are collected as scrap metal for recycling. Electrical components containing mercury, silver, lithium, or other toxic metals must be removed from the board prior to placing in the scrap metal bin. If not collected as scrap, circuit boards must be managed as hazardous waste due to the lead content of the solder
- Used pieces of electronics, such as scrap wire, cable, or fuses are either collected as scrap or deposited into the trash depending on metal content. As long as the equipment does not contain any mercury switches, lead, or other hazardous constituents, this material is recyclable (1.0.4).
- Used oil rags used for routine maintenance Lubricant is sprayed directly onto these parts and wiped with rags. All oily rags generated during maintenance activities are transferred to the EWMSD for disposal as industrial waste (1.0.5)
- The waste generated from the lead clean up of the Machine Shop in ATF is complete as of 2Q04. This project was managed by the EP Div. and the HP, along with the ECR, supported the effort [waste management] (1.0.6).

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
	Batteries	Non-alkaline: Universal waste as determined by process knowledge.	Non-alkaline batteries shall be accumulated as universal wastes and disposed of through the EWMSD. Non-haz. alkaline batteries: disposed of as regular trash.	None.
	Silicon Controlled Rectifiers, mercury switches, methanol.	Hazardous waste as determined by process knowledge (toxic metal content, silver, lead, mercury, ignitable).	Waste shall be labeled, placed in the satellite accumulation of Bldg. 820 and disposed of as a hazardous waste through EWMSD.	None.
	Capacitors and Transformers (primarily small, dry units) and printed circuit boards (after removal of hazardous components)	Equipment manufactured >1978 are non-PCB.	Waste shall be handled as industrial.	None
	Scrap Electronic Equipment, Wire, Cable and Fuses (after removal of hazardous components)	Non-hazardous solid waste T/B recycled as determined by process knowledge	Waste shall be handled as industrial/scrap metal.	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
1.0.5	Non-PCB oily rags with trace acetone/IPA/Ethanol (non-ignitable) and ethylene glycol coolant	Non-hazardous as determined by process knowledge (non-ignitable solids)	Waste shall be handled as industrial waste	None

2.0 Power Systems Group Maintenance Activities

This group maintains the klystron units and modulators that are part of the larger system producing power to accelerate electrons. A klystron is a high power RF amplifier that converts electrical power to RF power. The modulators provide pulse power for acceleration. Along with regularly scheduled maintenance, this group is responsible for repairing the system as necessary during emergency situations when power is lost.

History on PCB status of the Klystron Units

There are two klystrons in Building 820. The klystrons contain a cathode, which is immersed in a tank of oil for insulation. Oil-filled capacitors are also located in the tank of oil.

The klystrons in Building 820 have been repetitively retro-filled with PCB-free oil over the years. PCB analysis results from 1997 showed that the PCB concentrations in the klystrons was <50 PPM. Results in 2002 indicated that one of the two units in Building 820 had PCB levels of approx. 70 ppm. This PCB contamination may be a result of the PCBs leaching from inside of the tank as the capacitors were previously changed out. The ATF won Pollution Prevention funding in FY04 for the change out of the PCB-contaminated oil within the ATF-gun Klystron with non-PCB oil. The project generated about 2-55 gallon drums of PCB-contaminated oil.

General Maintenance Activities

Maintenance of the klystron units involves draining the oil from the unit, so that it can be repaired. Management of used oil and associated debris will depend on the PCB content of the klystron being serviced. The PCB concentration of the oil will be determined prior to disposal or will conservatively be managed as PCB-contaminated. The above ATF Klystron oil will be tested again to check for leach-out.

Regulatory Determination of Process Outputs

Klystron Maintenance, PCB Waste Management Methods & Spill Response

Oil drained from the klystron units has been reused, unless it has been contaminated with water. The used oil not reused is labeled with a green, non-hazardous waste label and placed in the 90-day area for pick-up by the EWMSD. Disposal is based on the actual PCB concentration of the oil and requires actual testing due to the above leaching affect.

When serviced in the future, any oil drained from these klystrons must be analyzed prior to disposal to determine PCB content or conservatively handled as PCB-contaminated oil (3.1). If oil containing 50 PPM PCBs or greater is generated, efforts will be made to replace it with non-PCB oil and the

waste oil shall be disposed of depending on its PCB concentration. Non-PCB oil from klystrons may continue to be managed as industrial waste (2.1).

During servicing and draining oil from the klystrons in 820, plastic or absorbent material shall be placed around the unit to avoid drips or spills of oil from contaminating the floor. All gloves, rags, floor coverings, etc. that come into contact with the >50 ppm PCB oil shall be containerized and managed as PCB contaminated waste (#2.2). If potentially PCB contaminated oil is spilled onto the concrete, the area will be cordoned off and the Control Room and x2222 will be notified to initiate the Lab's spill response group. PCB spills must be handled per: [Spill Response](#).


The residual PCBs are believed to be coming from internal, permeable components of the Klystrons since the older capacitors (high PCB concentration) were already replaced.

PCB contaminated waste is handled in accordance with the applicable SBMS requirements: [PCB Management](#). Oil-filled capacitors from the modulators are known not to contain PCBs, so are disposed of as industrial waste.

Point of Use Chillers

The ATF uses several portable, closed loop deionized water chillers that are connected to various ATF components. These point-of-use chillers are closed loop systems. In the event of a leak/failure of the system or if the system needs to be backwashed, the fixed volume of coolant may be contaminated with residual scale and metals from the chiller itself. Levels of copper or lead may be present in excess of BNL's SPDES permit discharge limits, preventing this waste from being acceptable for discharge to the sanitary system. The next time a backwash is conducted, the rinse shall be collected and a sample shall be collected for analysis (via Total Analyte Procedure-TAL metals). The results will be submitted to the Subject Matter Expert (SME) and the Liquid Effluent Evaluation Form will be completed prior to discharge. The ATF's ECR will assist with the sampling.

In the event a flushing solution is used for cleaning the chillers, an additional sample of the used flushing solution should be collected and analyzed (via – TAL metals) to characterize the waste for metal content, as the solution may also contain lead. If the discharge is not approved, then the material will be handled appropriately according to the lead concentration.

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
 2.1	Waste klystron oil from ATF Gun Klystron in Bldg 820.	PCB contaminated waste as determined by analysis (EPA Method 8080)	Managed as PCB-contaminated oil	None

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
2.2	Plastic coverings, rags, PPE, etc... that have come into contact with PCB contaminated oil (≥ 50 ppm).	PCB contaminated as determined by analysis and process knowledge.	Label and place in 90-day area for disposal through the EWMSD as PCB waste.	None (complete)
2.3	Oil filled capacitors from the klystrons in Bldg. 820.	PCB waste as determined by age of the capacitor	Label and place in 90-day area for disposal through the EWMSD as PCB waste	None (previously replaced)
2.4	Backwashing solution from Point of Use chillers	Hazardous waste (corrosive) $2 < \text{pH} < 12$ and may contain lead unless tested and proved otherwise.	Labeled and placed in the 90-day area for disposal through the EWMSD as corrosive and toxic waste.	None - disposal must be done in coordination with ECR when generated
2.5	DI water drain due to leak/maintenance	Waste characterization must be determined based on by TAL Analysis (metals). Not acceptable for sanitary discharge unless $6 < \text{pH} < 9$, and no SPDES permitted constituents present over release criteria.	Discharged to the sanitary system.	None - disposal must be done in coordination with ECR and SME using the Liquid Effluent Evaluation Form prior to discharge when generated.

3.0 RF Maintenance

Other miscellaneous maintenance activities are performed periodically throughout the facility. These activities include lubricating equipment, replacing damaged cooling system hoses and hose connections, and repairing or replacing equipment or parts that fail during operation.

Regulatory Determination of Process Outputs

During maintenance, cooling water hoses and hose connections associated with the linacs and beamline front-end components are routinely replaced due to damage from radiation. These parts are made of nitrile and are discarded as industrial waste. According to ATF personnel, the damaged parts are not screened for radioactivity due to the type of radiation emitted by the LINACS and accelerators; previous screening has confirmed this determination.

Any cooling water drained from the cooling system as part of system maintenance is typically released to the sanitary system. As this is DI water, disposal to the sanitary system is acceptable. However, as this work may occur on portions of the system that have not been working correctly, or that have not been used for some time, the water may have become contaminated with metals from the piping systems (possibly lead and copper). Past test results of DI water drained from various parts of the system generally indicate that the water is acceptable for discharge to the sanitary system. However, maintenance staff should be aware that atypical conditions might indicate that the water has become contaminated. Examples would include cloudy discharge, odd odors, or drainage of sections of the line that have not been used for a long time. If any atypical conditions present themselves, the water should be analyzed prior to discharge (ICP - metals), and approval for discharge must be obtained from the ESD SME using the Liquid Effluent Approval Form prior to discharge to the sanitary system (3.2).

Maintenance of cooling water system pumps involves replacement of worn parts (seals, etc.). Other cooling water components (e.g., flow switches) are replaced as necessary. Packaging cardboard and Styrofoam pieces are recycled (3.3).

Accelerator component maintenance involves lubrication of the beam stop shutters, actuators and valves. Lubricant is sprayed directly onto these parts and wiped with rags. All oily rags generated during maintenance activities are transferred to the EWMSD for disposal as industrial waste (3.4). Empty lubricant containers are collected in the empty aerosol can container for recycling (3.3).

Waste ID	Waste Description	Determination/Basis	Waste Handling	Corrective Action Required
3.1	Spent hoses, hose connections, new part packaging, non-metal parts and empty chemical containers	Non-hazardous solid waste as determined by process knowledge	Waste is handled as industrial	None
2.5	DI water drain due to leak/maintenance	Waste characterization must be determined based on by TAL Analysis (metals). Not acceptable for sanitary discharge unless $6 < \text{pH} < 9$, and no SPDES permitted constituents present over release criteria.	Discharged to the sanitary system.	None -disposal must be done in coordination with ECR and SME using the Liquid Effluent Evaluation Form prior to discharge when generated.
3.3	Cardboard, Styrofoam peanuts, aerosol cans and metal parts.	Scrap metal or other recyclable material	Each is segregated and collected for recycling.	None
3.4	Oily rags	Industrial waste (oil) as determined by process knowledge	Waste is sent to the EWMSD for disposal as industrial waste	None

III. Waste Minimization, Opportunities for Pollution Prevention (P2)

P2 Opportunities:

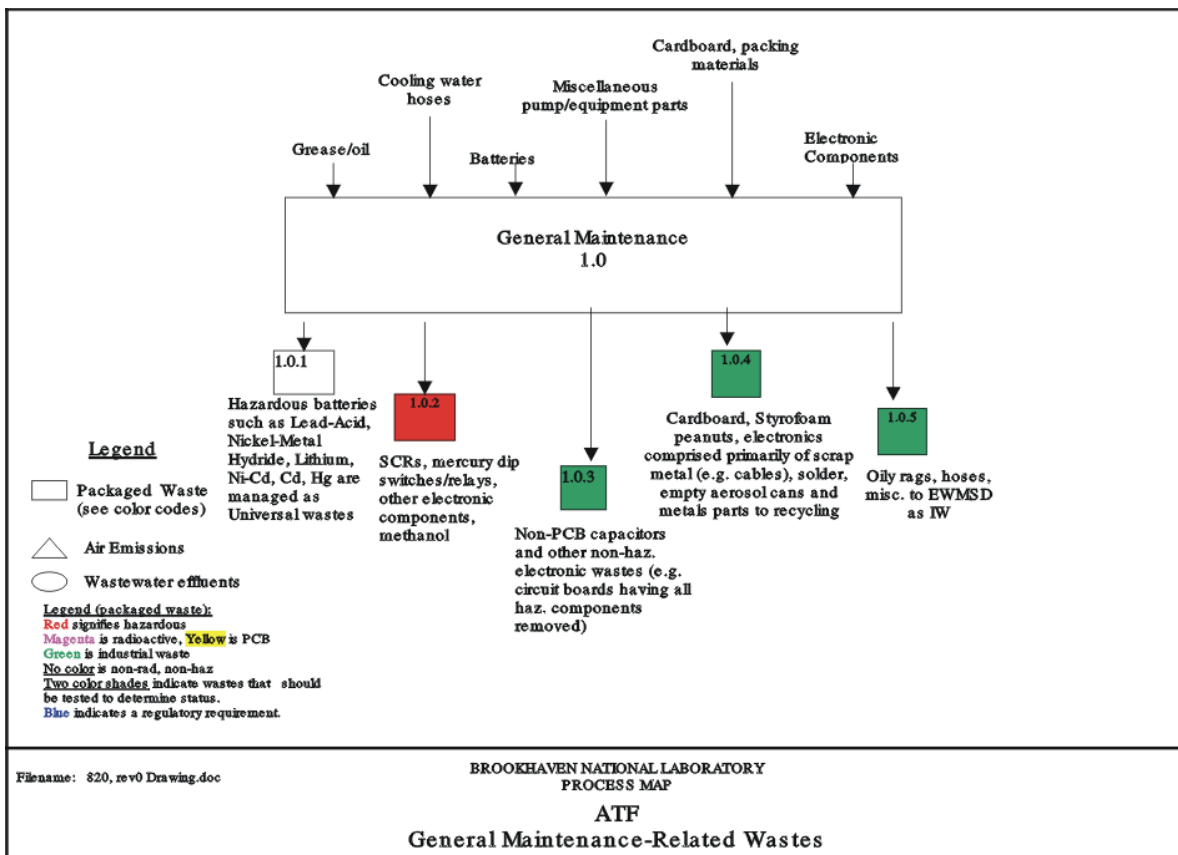
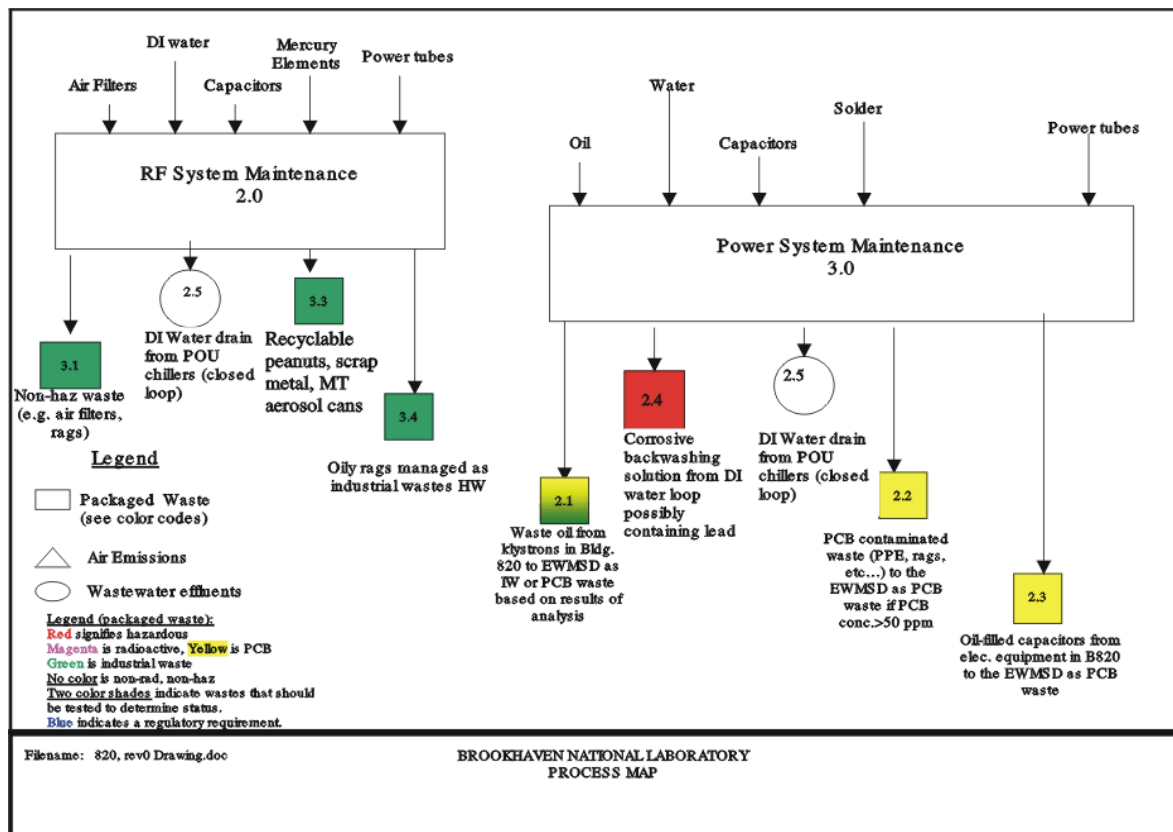
The ATF won a FY2004 P2 Award for the change-out of the PCB-contaminated ATF Klystron Gun oil.

IV. Assessment Prevention and Control (APCs)

New/Open APC Opportunities:

Prevention Assessment and Control Initiatives		
Original Process / Waste Stream ID	SOP, Inspection or other APC Measures Recommended	Resolution
2.5	Include the ATF's ECR in review of work procedures that include instructions regarding waste generation, disposal or other relevant environmental aspect (liquid discharges, air emissions, storage of hazardous materials, etc.)	Monitor when point-of-use chillers require draining

ATTACHMENT 1



BROOKHAVEN NATIONAL LABORATORY
RADIOLOGICAL CONTROL DIVISION

ANALYTICAL SERVICES REPORT

Chain of Custody Number: 22040909

Date Received: 4/9/02

Analysis Requested By: D. Bauer
Route Results To: Mark DavisExt. 5644
Fax 5812

The sample(s) listed below were received by the Analytical Services Laboratory for the determination of polychlorinated biphenyls (PCBs). The sample(s) were analyzed using EPA methods 608/8082. The data have been reviewed and meet all of the required quality control.

ASL COC Number	Bldg	Sample Description	PCBs ($\mu\text{g/wipe}$)	PCBs (mg/Kg)
22040909-01		ATF GUN KLYSTRON # 3748		68.9
22040909-02		ATF LYNGC KLYSTRON # 3149		1.6

Prepared By: Will Wang

Date 4/23/02

Reviewed By: Phil Hayde

Date 4/23/02

MDL: Method Detection Limit: 1 $\mu\text{g/wipe}$ or 1 mg/Kg (oil)